

interference of these currents at the intermediate surface breaks up the lower surface, or perhaps even the whole of the horizontal wedge of descending stratus, into rolls (or cumulo-stratus stretching horizontally in imitation of rolls) whose axes stretch from some northerly point to the opposite southerly point; the exact trend depends upon the relative strength of the upper and lower current. If the lower is the stronger, the trend will be southeast rather than southwest, and as stronger winds are nearer the lowest pressure, therefore the trend will vary with the distance from the center of low pressure around which these winds and clouds are circulating. If this center is near at hand and bears northwest from the observer, and if it is moving eastward, and especially if the observer's wind is south and the lower cloud motion from the southwest while the trend of these cloud rolls, or the perspective vanishing point of the parallel stræ on the lower surface of the sheet of stratus above the observer be east and west, then the region of heavy cloud and rain will probably not move or extend southward to his station, but passing eastward, will probably keep to the north of him. If the barometric depression is a long trough, these relations are modified and the rain may reach him. If the trend of the axes of the rolls is from southwest to northeast and is then soon observed to change so as to become northwest and southeast, this indicates that the clearing region is rapidly approaching with its cooler air and that there is less prospect of rain.

But as these phenomena are affected by the topography of of the surrounding country, therefore such rules for Washington may not apply strictly to another locality, and the Editor will be pleased to publish such rules as others may have deduced.

#### HOAR FROST ESPECIALLY RICH IN NITROGEN.

(Translated from A. LANCASTER in *Ciel et Terre*, XVII, p. 54.)

Messrs. Petermann and Graftiau in a memoir, published by the Academy of Sciences of Belgium, and entitled *Researches on the Composition of the Atmosphere*, demonstrate the special richness of hoar frost in nitrogenous compounds, and draw attention to the important part that hoar frost plays in adding to the stock of nitrogenous matters in the forest, as well as to the purifying influence that the forests exercise on atmospheric air.

The truly remarkable richness of hoar frost merits attention as one of the interesting points in the complicated mechanism of the circulation and distribution of nitrogen throughout the world. The frost work which is attached to the branches of trees presents to the air, which surrounds it and is continually renewed, a large surface for the absorption of all the soluble bodies that it carries, and the isolated trees, the plantations, and the forests act like immense filters purifying the air that circulates through their foliage, robbing it of those nitrogenous combinations which, being returned to the soil by a thaw, serve again as nutriment to the plants and thus reenter the vital cycle. When one sees the branches of the trees bending under the weight of the frost, when the latter accumulates to the point of breaking the larger branches, we should recognize that this represents an appreciable factor in the stock of nitrogenous material accumulated in the forests.

The following analyses of one liter of melted frost collected at Gembloux, Belgium, are given in the above work:

	Milligrams of nitro- gen.
March 1, 1889 .....	5.86
January 2, 1890 .....	7.70
December 31, 1890 .....	9.00
December 31, 1890 .....	8.00
December 31, 1890 .....	7.02
Average .....	7.52

During the severe cold of the winter 1894-95, M. Graftiau made some further measurements for the purpose of also taking account of the quantity of frost actually attached to the branches. On February 7, between 9 and 10 a. m., and

at a temperature of 16° C. below zero (plus 3.2° F.) he collected the frost attached to different species of trees growing in the arboretum of the agricultural institution at Gembloux. The branches that were heavily laden with frost were gently detached and then shaken over a sheet of paper. The frost was then collected in a dish and weighed. In this way we could only obtain a part of the frost, therefore, the figures cited below are the minima. The quantities obtained were as follows:

Species.	Weight of—		Surface of branch.
	Frost.	Branches.	
	Grams.	Grams.	Sq. cm.
<i>Cornus sanguinea</i> .....	2.0	2.0	30
<i>Populus alba</i> .....	2.8	3.6	36
<i>Ribes saxatile</i> .....	5.5	2.5	100
<i>Salix alba</i> .....	34.1	15.0	203
<i>Salix vitellina</i> .....	39.3	32.1	270

Graftiau also weighed the frost on an entire shrub (*betula rotundifolia*). The cube limited by the extremities of the branches was about 1.5 meters on a side; the weight of the frost was 1.755 kilograms. The melted frost was analyzed and each liter contained: 4.0 milligrams of nitrogen as ammonia and 1.2 milligrams of nitrogen as nitrates and nitrites, or a total of 5.2 milligrams of combined nitrogen.

This frost of February 7 was not at all remarkable, and yet we see that its weight exceeded 1 kilogram for each cubic meter of space occupied by the branches. In mature forests the branches occupy, at a low estimate, a space of about 100,000 cubic meters to the hectare, and can, therefore, collect 100,000 kilograms of frost which represent, approximately, half a kilogram of combined nitrogen, if we adopt as the base of our calculation the small amount of frost that collected on the branches during the severe frost of February 7. If, for an average, we take 7.5 milligrams instead of 5, the deposit would be nearly 800 grams of nitrogen to the hectare, or 7 pounds to the acre.

Frost is sometimes formed to an extraordinary amount. It is then capable of breaking by its own weight branches that are 10 centimeters in diameter, which happened some years ago in different parts of the country. Therefore, the quantity of nitrogen that is given to the soil by the frost that falls on it is very considerable.

These authors, therefore, have with good reason said that the frost represents an appreciable factor in the reserve of nitrogen within forest areas. If we add to this the nitrogen contained in the rain, the dew, and the fog, we can easily explain why, without any artificial addition of nitrogen and without the intervention of those plants that serve to fix atmospheric nitrogen, the forest vegetation is always well supplied with nitrogen, and it also shows how the soil of forest areas grows richer in this element which is given to it by the detritus, or the waste of the forest.

[May we not also suggest that the stunted foliage on the summits of mountains, fed as it is by the melting of frost and snow, may be peculiarly well supplied with nitrogen.—C. A.]

#### ATMOSPHERIC REFRACTIONS AT THE SURFACE OF WATER.

In response to an inquiry about mirage, the Editor has collected the following notes from recent publications:

Prof. Charles Dufour of Lausanne communicated to the Academy of Sciences at Paris a memoir, of which Mr. Lancaster (*Ciel et Terre*, April, 1896, Vol. XVII, p. 88) gives the following summary—

Abnormal refractions are often observed on Lake Leman [*i. e.*, Lake Geneva, Switzerland]. If the air is colder than the surface water we have conditions favorable for mirage; the path of the curved